Inconvenient Data
Experiments Capturing PACTOR-3 Communications with a Raspberry Pi (without any PACTOR modem)

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RE: PETITION FOR DECLARATORY RULING[1]

EXECUTIVE SUMMARY

Since I have already disclosed[2] (and even provided web links to[3]) multiple examples of WINLINK PACTOR messages decoded, in whole or in part, using free software and the PMON command for currently marketed SCS DRAGON modems, and *that is rather perfunctory now even under difficult deployed circumstances, miles from the linked stations being surveilled*, it is now time to move forward and study the available free software for repeating those feats without even a PACTOR modem, only using a simple Raspberry Pi single board computer and a sound card [4]

Special-purpose hardware/software SCS PACTOR modems provide advanced advantages; therefore I created a very simple solution to create a handicap of roughly 3dB at low signal levels. There are certain limitations to the simple technique, which are discussed. Actual experimental data was gathered over the air (not mere theory) for several compressed messages. Results demonstrate the Raspberry Pi performs reasonable well when given a modest low-power advantage over the special-purpose modem, given a "floor" on how much the special purpose modem can cut down the available "margin."

But that isn't the biggest news from these actual experiments.

These experiments demonstrated, for the first time, an instance where the independently monitoring Raspberry Pi actually captured a portion of the message, while the intended recipient disconnected and received *nothing*, using standard WINLINK software. Although this is predictable from understanding the nature of WINLINK standard software and the recent advances provided by Peter Helfert[5], no one

1 NYU: https://ecfsapi.fcc.gov/file/10242392005642/NYU%20Wireless%20Petition%20for%20Declaratory%20Ruling%20-%2010.24.19.pdf
2 Gibby: https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf
3 See various directories at https://www.qsl.net/nf4rc/Tech/RaspberryPiWinlinkDecoder/
4 SCS: https://www.p4dragon.com/en/PMON.html
5 Helfert rewrote LZHUF_1 so that it begins providing output almost from the beginning, rather than only after accumulating the entire file, as it had been used for 2 decades.

seems to have discussed this event where the "virtually impossible" trumps the supposedly guaranteed result. Virtually impossible[6] somehow became "magically better?" This actual demonstrated event should give pause to regulators and others thoughtfully evaluating the many unsupported theoretical claims being made within the fatally flawed Petition.

These data, along with already disclosed data, allow calculation of ballpark estimated probability that a diversity technique would allow a determined group of monitoring volunteers using automated software to successfully monitor WINLINK transmissions -- all of them. The data demonstrate that rather than being "virtually impossible," success is actually rather well assured, and that it could have been achieved at any point in the past 2 decades. Some implications of this finding are discussed.

INTRODUCTION

I have previously published data on the successful monitoring (as a surreptitious third party) of WINLINK transmissions between two completely separate stations, the sending one of which was separated by 900+ miles.[7] In that instance, I was able in several circumstances to recover complete messages. Additionally, analysis of the results demonstrated the experimental verification of the efficacy of diversity receiving[8] (which is already well known[9] [10] [11] [12] [13], of course, just not yet applied often in amateur radio except by contest officials and perhaps by those performing single-operator-two-receiver contesting). That previous experimental work was done using the capabilities of the PACTOR modems, all of which have the ability, with suitable software, to monitor PACTOR signals (WA8DED hostmode); currently-manufactured ones can monitor also with PMON commands. The following Table summarizes the previously disclosed results:

Date	Reference	Finding
08/30/2019	ANNOUNCEMENT OF CREATION OF FREE SOFTWARE TO READ	Announcement of free software to decompress WINLINK PACTOR messages

6 The term used three times in the Petition to discuss reading WINLINK messages. For example: "...although they make it virtually impossible to readily decode the communications for true meaning ..." p. 5. https://ecfsapi.fcc.gov/file/10242392005642/NYU%20Wireless%20Petition%20for%20Declaratory%20Ruling%20-%2010.24.19.pdf

7 Gibby: https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf

8 See Section 3, https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf

9 As early as World War II, diversity receiving was being utilized: War Department Technical Manual TM 11-872A http://www.tmchistory.org/PressWireless/manuals/prewi_frr-3a_manual.pdf

10 IEEE (1954): https://ieeexplore.ieee.org/document/4051767

11 https://en.wikipedia.org/wiki/Diversity_scheme

12 Sachdeva and Sharma, https://pdfs.semanticscholar.org/0c90/182132ba22587281f65081228bc99f20fc8a.pdf

13 Tse, https://web.stanford.edu/~dntse/Chapters_PDF/Fundamentals_Wireless_Communication_chapter3.pdfsee particularly Section 3.3.1 Receive Diversity discussing the effects of receiver diversity on reception of fading signals, and eq. 3.71, demonstrating that for every doubling of the antennas, a 3dB gain is achieved.

	WINLINK AND DISCUSSION OF HOW TO AVOID FUTURE TWO-DECADE DEBACLES https://ecfsapi.fcc.gov/file/10830048730238/FreeSoftwareToReadWINLINK.pdf	captured using PMON on a Dragon SCS Modem. Example decompression presented. Explanation of the protocols developed by F6FBB since 1986.
8/4/2019	Express Comment https://www.fcc.gov/ecfs/filing/10904245343229	Announcement of software errors discovered and correction; announcement of free web storage of results of captures and software
8/19/2019	Inconvenient Truths About WINLINK & FLDGI/FLMSG: Disclosure of Experimental Findings, Advanced Developments, and Discussions https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf	Texts captured from messages on September 8 and September 10 over 900+ miles in a hot pick up truck at a bus-stop with an improvised antenna, and a transceiver sitting in the passenger seat. Not exactly a laboratory setting.... Appendix 5: Presentation of compressed FLDGI/FLMSG text (not encrypted; challenge issued to use same standards of evaluation to all compressed systems)[14]
October 31, 2019	INCONVENIENT OBSERVATIONS https://ecfsapi.fcc.gov/file/1031895715302/InconvenientObservations.pdf	Page 11: To assist those having difficulty understanding how well this has been accomplished, public URL links were provided for 3 messages captured in more laboratory conditions, and 4 messages captured over 900 miles in completely austere conditions in a pickup truck at a bus-stop, far from the actual stations involved in the communication, messages that transited 900 miles. Additional announcement that the first message had been decoded by me, in a travel trailer, on vacation, using only a Raspberry Pi 4. (bottom of page 11)

TABLE 1. Disclosures of successful WINLINK PACTOR captures.

Having demonstrated that one can fairly easily monitor some or all of WINLINK PACTOR communications using a DRAGON modem and free software[15], it is time now to turn to testing the monitoring using a simple Raspberry Pi system and soundcard. As explained, I have already done

14 FLDGI/FLMSG: Any person skilled in the art would be able to easily create software to read these compressed texts. They are not encrypted, and the software that created them is public domain. Yet they meet all the criteria used by many to claim they are effectively encrypted....yet these same persons never attack FLDGI/FLMSG. Why?

some experiments with the earliest released software for the Raspberry Pi. Peter Helfert has recently released updates to his first-ever Raspberry Pi Pactor 1,2,3 freely distributed executable code. Thus I report on the usage of version 1.0-2.

Further technical details of the mechanics of the current test, including schematic, discussions of the limitations of the setup, and the presentation of exactly what was receieved in each case, are provided in the Appendix.[16]

EXPERIMENTAL RESULTS

Result #	Outcome	Freq-uency	Gateway	Distance (miles)	Message size (characters)	Comment
1	Perfect reception	3.588 MHz	WD4SEN	53	602	
2	Perfect reception	3.588 MHz	WD4SEN	53	684	
3	Incomplete reception	3.588 MHz	WD4SEN	53	929	Missed latter portion of message
4	Perfect reception	7.1037	AJ4FW	534	1248	Handicap noise was increased to approximately 3.3 dB. Perfect message reception while intended WINLINK system reporting 600 bps connection; message included multiple previous copies being replied to.
5	Incomplete reception	3.5925 MHz	WW4MSK	377	2558	Captured message body perfectly, but missed portion of attachment. Intended recipient system was struggling. Tremendous fading to negligible signal multiple times (notes say "signal disappeared"); repeats went to 8 times several times--this came close to aborting.
6	Total Miss -- didn't get	not recorded	not recorded		not known	This one failed completely; I neglected to write down the

15 Or with any model of PACTOR modem, and sufficient software created to exploit the WA8DED HOSTMODE and integrate with the freely available code which I have written, which handles it from that point.

16 At the earnest requests of my patient copy-editors.

	anything					details unfortunately.
7	Partial capture	7.1016 MHz	KB5LZK	669	not known	Possibly most important experimental result, because intended recipient got NOTHING -- quit! See discussion below.

Table 2: Experimental Results

Result 7 Details:
This is the most surprising experiment result, an example of the Raspberry Pi capturing a portion of the message (and immediately delivering it due to the advancement of the LZHUF routine by Peter Helfert) --- but the intended recipient (the Pactor modem and WINLINK software) reached the maximum number of retries and ***aborted*** -- which means nothing was provided to view, at all. [Measurements as detailed in the Appendix indicated approximately a 3.3 dB handicap.]

The system claimed to have virtually no chance, produces a partial monitoring of the message, when the system presumed to be the gold standard got NOTHING!

Notes created at time of experiment:
40 meters to kb5lzk. signal is dropping out. PMON got a bunch and then lost it The pactor is struggling.-- and eventually QUIT -- so the intended recipient computer NEVER got to read the message. Meanwhile, the monitor gets to read a good portion!

NOTE1: This is an example of a message originated "on the internet", in this case by Wayne Robertson at the red cross related to an Exercise (who is also an amateur radio operator) and shows the usefulness of this ability.

NOTE2: Because this message was NOT successfully moved over the air, it does not appear in the WINLINK VIEWER --- but my Raspberry Pi picked up enough to get the sender, the subject, the actual message, and some of information being replied to.

The WINLINK EXPRESS actual intended recipient captured zero. When the system reaches maximum retries and quits....there is nothing given to the user to see, at all.

FINAL SCOREBOARD

Situation	**Result #**	**Count**	**%**[17]
Raspberry Pi Failed Completely	#6	1	14%

17 Rounded to nearest whole percent.

Raspberry Pi Captured Partial	#3, #5	2	29%
Raspberry Pi Captured Complete	#1, #2, #4	3	43%
Raspberry Pi Outdid PACTOR/WINLINK standard software (counted in partial as well)	#7	1	14%[18]
TOTALS	7 total cases		

Table 3: Final Scoreboard

DISCUSSION

1. Real Messages, Real Measurements

All of these messages were real messages that happened to be out there waiting for me when I had the chance to do this experiment. None of them were created specifically for this experiment. And as it turns out, comparison of the sizes of these messages shows they are actuallly very typical for those carried on the WINLINK system by radio (see Figure 1, Appendix). Probably just like everyone's email, different messages run the gamut from quite short to extremely large. Because radio WINLINK message are sent over low speed radio, I happen to have set an absolute limit about 40kbytes, and in practice, I will assiduously avoid anything above 10Kbytes. Most messages for me are probably only a few hundred characters. But longer than the typical NTS radiogram (25 "groups" plus preamble.)

This is a very crude method to get a ballpark estimate of the advantage the PACTOR modem's special features have over the simple Raspberry Pi sound card monitor at the lowest RF signal inputs (the area where problems are expected). Since the distribution of the means of samples of most processes follow the Central Limit Theorem[19], one can often use simple statistical measures to communicate useful data about a process. The number of tests performed in this series of experiments is very limited, however, with the Raspberry Pi doing reasonably well in the tests with an advantage of approximately 3.3dB (at lowest signal levels) and upwards (at higher signal levels), the data suggest that the advantage of the Pactor special hardware/software is likely somewhere in the range of 3 dB or a few more. Admittedly, this is a very inexact measurement, but so far it appears to be the ONLY known measurement. Persons more knowledgeable than I might be able to construct some sort of a "receiver operating characteristic curve" and come up with a better statistical definition of the advantage.[20] [Just another example of the research that is awaiting in advanced digital amateur radio communications.]

Now before proceeding to show how this new bit of information can be applied, a few issues have to be examined.

18 Will not add to 100% because case 7 fits in two categories.
19 https://en.wikipedia.org/wiki/Central_limit_theorem
20 https://en.wikipedia.org/wiki/Receiver_operating_characteristic

2. Petition Aims to Alter Terms Controlled By Treaty Obligations[21]

It would seem to be important to note that the Petition apparently wishes to change U.S. Regulations in ways that disagree with our treaty obligations to the ITU-R regulations, and obviously with disregard to the actual actions of the ITU.[22] The Petition requests a change the current reading of FCC regulations governing prohibited transmissions, which states in part,

> (4) Music using a phone emission except as specifically provided elsewhere in this section; communications intended to facilitate a criminal act; **messages encoded for the purpose of obscuring their meaning, except as otherwise provided herein**; obscene or indecent words or language; or false or deceptive messages, signals or identification. [23] [emphasis added]

such that it adds additional proscriptions against

> **"...the transmission of effectively encrypted or encoded messages, including messages that cannot be readily decoded over-the-air for true meaning"**

The Reason The Regulations Read the Way They Do

The actual current wording of this FCC Regulation (from 2006) for amateur transmissions was apparently crafted specifically to reflect the ITU Radio Regulations from the WRC-2003 conference.[24] The Petition however appears to (mistakenly, and **fatally**) rely on an outdated document from 1995[25] in which a footnote relates to a superseded version of the ITU Regulations,

> 6 The HF bands are widely used for international communica tions. Number 2732 § 2.(1) of Article 32 Section I of the International Telecommunications Union *Radio Regulations* re quires that transmissions between amateur stations of different countries be made in plain language. Section 97.113(a)(4) of the Commission's Rules, 47 C.F.R. § 97.113(a)(4), therefore, prohib its amateur stations from transmitting messages in codes or ciphers intended to obscure the meaning thereof.

With the advent of so many different digital techniques by the time of the WARC-2003, the language of the ITU regulations changed, and the FCC regulations were subsequently updated in 2006, to reflect the actual current ITU regulations. The Petition evinces unhappiness with this fact, and effectively requests the United States to revert to the earlier ITU regulations.

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In so doing, it is unclear whether the Petition research recognized that the very ITU on which they based their argument, is sponsoring multiple WINLINK gateways in Central America and the Caribbean....again fatally undercutting the Petition's claims.

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21 I am indebted to the ARRL's expert legal counsel for pointing out this error by the Petition. I had mistakenly assumed that the Petition referenced currently applicable documents in making its [flawed] argument.

22 Noting that the ITU is sponsoring multiple WINLINK stations in Central America and the Caribbean.

23 FCC: https://www.ecfr.gov/cgi-bin/text-idx?SID=d4b3c60d2d60000a147f885bdee88264&mc=true&node=pt47.5.97&rgn=div5#se47.5.97_1113

24 Sumner: http://www.arrl.org/files/file/QST/This%20Month%20in%20QST/October%202013/OCTOBER%20editorial.pdf

25 FCC: https://docs.fcc.gov/public/attachments/DA-95-2106A1.pdf

3. Multiple Missing Explanations

A) Further, desiring to "turn back the clock" on the ITU, the Petition **fails to use a valid engineering term**[26], and provides no definition of "effectively encrypted." Basically, the petition seems to downgrade in importance, and even oppose some of the real goals of amateur radio, expressed specifically in 97.1 (b) and (c):

> (b) Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.
> (c) Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.

B) While attacking public compression that has been utilized by multiple systems for decades[27], the NYU Petition fails to identify a "static and public compression solution" that works optimally for all languages, and all data types, yet demands the usage of such unspecified system. What is in PACTOR modems has algorithms for German and English text. What about all the other languages?

C) The Petition makes the astonishing claim of ignorance on the part of the Federal Communications Commission regarding its 2006 rule changes to 97.113(a)(4),

> *"When it drafted Section 97.113(a)(4), the Commission could not reasonably have intended for its Amateur Radio Service rules and the Amateur Radio Service's primary enforcement mechanism (i.e., the self-policing by other Amateur Radio Service users) to be rendered toothless."*

thus **suggesting a lack of awareness that these exact LZHUF_1 compression and ARQ systems had been in use by FBB bulletin boards since at least 1993**[28], and by WINLINK since at least 2000 or before. Certainly both the ITU (2003) and the FCC (2006) were not in the dark of the exciting advances being made in amateur radio.

D) The Petition fails to recognize that by citing (in 97.309(a)(4)) multiple modulation techniques well known (CLOVER, G-TOR, or PacTOR) and technically described on web pages maintained by the ARRL:

> CLOVER[29]
> G-TOR[30]
> PacTOR[31]

26 Is "effective encryption" that sort of encryption which is well accomplished? Or is it some pseudo-encryption? This is remarkably ambiguous.
27 Usage of LZHUF_1 has been demonstrated at least as early as 1993.
28 LZHUF binary compression was in usage by at least 1993; as it existed in FBB version 515, which was extant in 1993. Personal Communication, John Wiseman.
29 See http://www.arrl.org/clover
30 See http://www.arrl.org/g-tor
31 See http://www.arrl.org/pactor

the FCC explicitly approved of **at least one modulation which was not public domain and required special proprietary hardware** (as have many techniques at various times in history). And in spite of at least one of these not becoming public domain[32], there are 3rd party receiving systems for all of these commercially available[33] as there are for Pactor II, III, IV,[34] rendering merit-less any claim that sufficient information is not available to create solutions to read these transmissions.

4. Evaluating Possibilities for Self Policing

Underlying the Petition's erroneous goals in the 2nd half of their petition, in which is stated,

> "A narrow interpretation undermines amateurs' efforts to self-police the amateur bands, consistent with long-standing Commission policy,"

are the implicit assumptions by the Petition that amateur radio operators would actually sufficiently undertake over-the-air self-policing to deal with any instances of any individuals violating the rules if such monitoring were technically feasible.

(4A) This is a surprising implicit assumption on the part of the Petition, given that there is no evidence presented within the Petition of any experiments using the **available systems** created specifically for such monitoring. The many factually incorrect assertions within the Petition

- "For years, certain amateur licensees have skirted these requirements,7 sending and receiving communications over amateur bands using communications modes that incorporate dynamic compression techniques8 and, by extension, effectively encrypt or encode the communications.9 "[35]

- "...which allows only two linked stations to complete a transmission without error. "[36]

- "Other licensees will thus be unable to reconstruct the decoding and compression scheme and, by extension, unable to decode the message for true meaning. "[37]

- "At least two commenters have claimed that Winlink messages may be monitored over-the-air, albeit under unrealistic, controlled conditions that do not represent reasonable propagation conditions."[38]

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32 Personal Communication, John Escenfelder, Barrett USA, was unaware of any public domain release of the CLOVER software.

33 See, for example, http://www.wavecomusa.com/docs/2018-product-specifications_usa.pdf

34 See page 11 of http://www.wavecomusa.com/docs/2018-product-specifications_usa.pdf

35 Petition appear unaware of updated ITU regulations, of ARRL explanations, and of published results that directly contraadict this incorrect assertion.

36 False claim, multiple submissions to the contrary of actual experimental results, documted in Table 1 of this document.

37 False claim, multiple submissions to the contrary of actual experimental results, documented in Table 1 of this document.

38 False claim. 20 meter 900+ mile fading communications intercepted in a hot pickup at a suburban bus-stop probably is one of the more UNcontrolled conditions possible. https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf

all suggest that the **Petition evidences <u>no personal experience</u> with monitoring PACTOR WINLINK transmissions**, despite the software to do so being freely available.

(4B) The data being presented in this document augment the proof that self-policing [even without the Winlink Viewer] is *already is possible*; *has been possible for quite a while*, as will be discussed below, and yet as the Petition itself admits, *was never accomplished as well as desired*....until the WINLINK development team provided the WINLINK Viewer. It is now patently obvious that effective amateur radio self-policing applied to the WINLINK sector <u>is very effective</u> for modifying the behavior of users[39] -- the production of the Winlink Viewer -- and actual record of over-the-air transmissions, which even includes a 21-day history -- allowed the objective demonstrations that

- the level of even "objectionable" WINLINK emails (not necessarily violative) before any known intervention was 1.1%
- that level subsequently declined by two orders of magnitude within months

As I have pointed out multiple times, there is NO similar objective data of self-enforcement for any other area of amateur radio, a fact not mentioned by the Petition.

<u>(4C) ***This could have been done years ago without the WINLINK Viewer***</u>
The WINLINK system utilizes advanced digital communications (advanced at least for the year 1999). The FC protocol comes out of systems that were first begun in 1986[40]. The development of the WINLINK system, and various radio modulation techniques were certainly not conducted in secret, Rather, it has been widely publicized, including web technical data and presentations at Conferences, with training (of varying degrees of accuracy and excellence[41]) given all over the nation during the past 2 decades. All amateurs, and certainly experts, have had every ability to be aware of all of the features.

The usefulness of the measurements detailed above, is that they help to predict the requirement for a determined monitoring group to monitor, on air, targeted WINLINK receiving stations--**even using simple soundcard systems, rather than robust PACTOR modems**.

The WINLINK system was developed over decades, and currently has approximately 65 PACTOR-capable radio message server stations.[42] Each station possibly has $2100 of voluntarily donated usage of equipment.[43] This suggests a total equipment asset base [on the part of gateways] for this one technique of potentially less than $200,000.

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39 Gibby: https://ecfsapi.fcc.gov/file/10822196770221/ReAnalysisOfWinlinkObjectionableMessages.pdf
40 See technical documentation available at: http://www.f6fbb.org/
41 It is not uncommon for WINLINK detractors to cite nonofficial unauthorized persons' or groups' opinions to buttress their points.
42 Based on a simple count of the PACTOR RMS stations shown on the map at https://winlink.org/RMSChannels
43 Estimating $500 for transceiver, $1000 for PACTOR modem, $300 for suitable antenna systems, and $300 for computer equipment

What would be required for a group of determined monitors to monitor every PACTOR transmission by the entire group of USA WINLINK Pactor gateways? Obviously, due to the advances of these 65 volunteers and the software and hardware systems created in these advances, the determined monitors will also need to advance their techniques, beyond those of the 1970's, and I've suggested multiple times that **diversity reception** (known since at least 1926[44]) be implemented, which should be no great difficulty for the acknowledged experts expressing concerns that monitoring be possible. These techniques are quite well known to NYU, which certainly has vast expertise in the advantages of antenna and spatial diversity.[45]

Experimental results for the case of WINLINK Pactor communications similarly demonstrated evidence of independence of fading in recent tests using 9 mile separation between two receivers.[46]

High Level Probability Proof

A high level proof of the advantages of diversity reception, assuming only *independence* of receivers, proceeds as this:[47]

Assume n separate receiving systems with independent reception, stations denoted by $i = 1, 2...n$

The probability of completely **perfect** reception of an individual packet by each station be denoted by P_i

Then the he probability of a packet being incorrectly received by that station is

$$p_i = [1 - P_i]$$

Then because the probabilities are independent, the probability of ALL stations being unable to capture a given packet [thus the packet is not received at all, and the message is interrupted] becomes

$$p_{diversity\ failure} = [1-P_1]\,[1-P_2].....[1-P_n]$$

The only known data extant for actually monitored WINLINK Pactor data with diversity analysis comes from the table ANALYSIS OF MISSED FRAME BY RECEIVING LOCATION, GEORGE WASHINGTON FAREWELL ADDRESS on page 28 of my previous publication Inconvenient Truths About WINLINK & FLDGI/FLMSG: Disclosure of Experimental Findings, Advanced Developments, and Discussions , September 19, 2019[48], wherein the George Washington Farewell Address (>36,000 characters) was [attempted to be] monitored using a Pactor modem 9 miles from the intended recipient, and 900+ miles from the sending station, over an actual fading 14 MHz propagation path in the afternoon in the front seat of a hot pickup truck at a bus-stop, using a wire antenna launched over a

44 Kovacs reports that experments by Beverage and Peterson, working for the Radio Corporation of America (RCA) experimented with spatial diversity reception and demonstrated independent fading in the 1920's, moving to antennas only 100 meters apart, by 1926. http://www.hadmernok.hu/2013_1_kovacsr_2.pdf

45 Sun & Rappaport, https://wireless.engineering.nyu.edu/static-homepage/tech-reports/TR_Shu.pdf ; see 1.3.1; also note discussion of automated systems to pick best antennas.

46 https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf See analysis of experimental data, pp 26-30

47 Peter Helfert carefully explained this probabilistic analysis to me; it is not original with me. I merely added the actual experimentally derived probabilities from my own experimentation results.

48 https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf

convenient tree and a dog-leash retainer screwed into the ground. 25 packets total were transmitted in that transmission, and missing packets were as follows:

Intended Recipient	**Monitoring Station**
Missed 5/25 packets	Missed 3/25 packets
$P_1 = 0.8$	$P_2 = 0.88$

Table 4. Observed Probability of Successful Packet Capture

This leads to probabilities of correct capture in this real-life experiment of 0.8 and 0.88.

Notice that the entire transmission of this 36,000 character file (very, very large by WINLINK standards) took only 25 packets. This is due in in part to compression, and in part due to moving to "long" packets and higher speed levels on the part of the modem. It must be emphasized that while compression using LZHUF_1 has the monitoring disadvantage that complete loss of a packet means later reconstruction becomes difficult to impossible....**it has the advantage that quite fewer packets have to be captured! To move the entire George Washington Farewell Address in 25 packets is quite remarkable and appears to have been ignored by the Petition.**

NOTE: I do not believe the filings record yet includes any objective data on the typical size data of WINLINK USA radio-transferred (including VHF/HF/UHF) messages. Therefore, I captured data on the 500 previous sequential records prior to 1734Z on Nov 24 2019 (presumably a reasonable sample set) and using a spreadsheet, created a histogram of messages sizes with a bin size of 500 characters, resulting in the following figure:

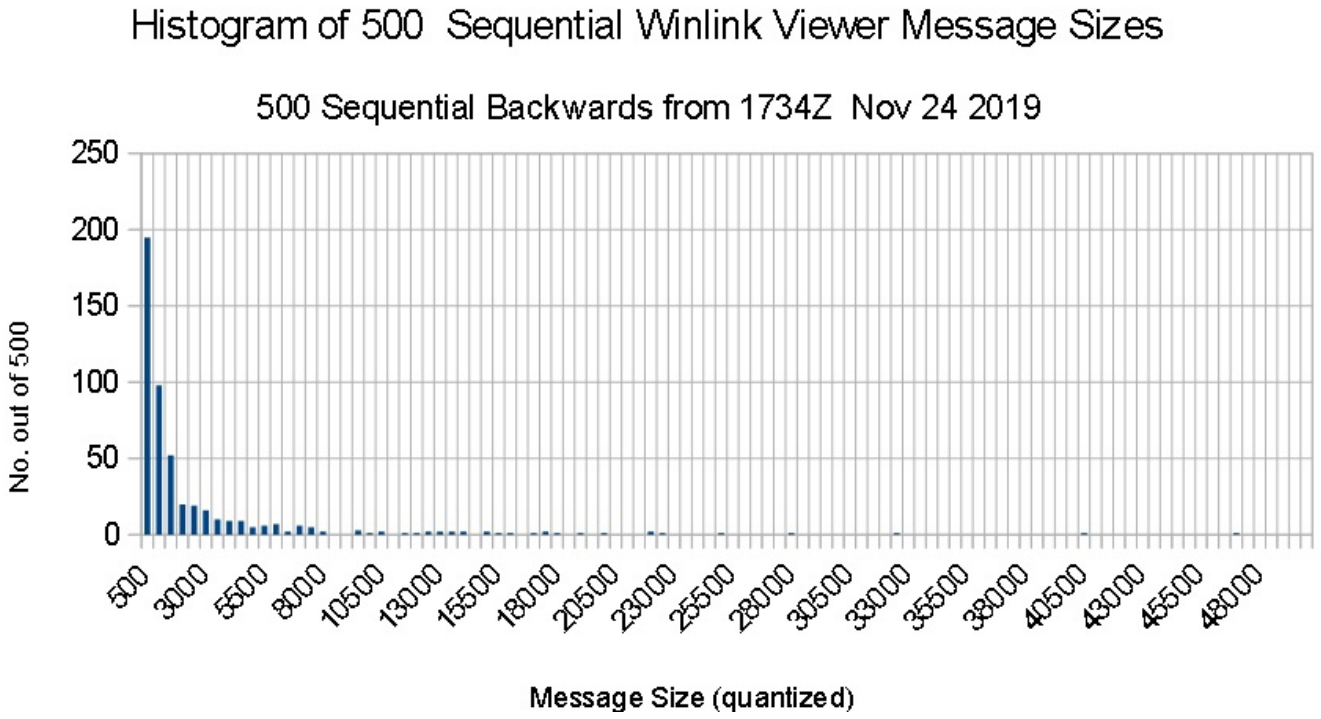

Figure 1: Histogram of sizes of 500 sequential WINLINK radio-transferred messages

Based on that histogram it is safe to make the assertion that a 36,000 character George Washington Farewell Address is a "large" file for radio-transferred Winlink. It appears that anything larger than 5000 or 6000 characters is "large" for WINLINK. Most messages are *much* smaller.

Taking the **worst** of these two experimentally measured packet capture probabilities, 0.8, one can calculate the number of stations required to achieve a 99% probability of getting an individual packet correctly (or <1% chance of total failure) as

$[1-0.8]^n < 0.01$, n restricted to whole numbers

$0.2^n < 0.01$

$n >= 3$

(at which point the probability of a packet being satisfactorily received by at least ONE of the three stations is 0.992 (99.2% chance of success for each packet).

And note that in the actual experiment reported, data extrapolation indeed suggested that **with only the data from the *two* stations involved, the entire file would have been reproduced** without the ability to demand re-transmissions.

And in fact with THREE stations of the worst probability (0.8), resulting with a 99.2% success rate on each packet, **the probability of capturing all 25 packets successfully** in any given try (assuming independence) is $(0.992)^{25} = 0.818$ (81.8%). In other words, 81 times out of 100 trials, the entire George Washington Farewell, a huge message by WINLINK experience, would have been captured successfully, using 3 independent stations, each missing 20% of packets.

Even with only the TWO stations actually involved in the published test, assuming independence and continuation of their observed probabilities (0.8 and 0.88) the probability of an individual packet being successfully captured by a diversity system would be

$$p_{\text{diversity success}} = 1 - (0.2)(0.12) = 0.976 \quad (97.6\% \text{ chance of success for each packet})$$

The probability that one test would be successful [as my extrapolation of the received data suggested my test would have been successful with diversity software] becomes

$$0.976^{25} = 0.545 \quad \text{or 55\% chance of success!}$$ I was on the good side of that probability.

The data on which these engineering analyses were calculated, were published on Sept 19, 2019[49].carefully explaining the 900+ mile experiment. The Petition being discussed was filed on October 24, 2019, more than 30 days later. It is not clear why the prestigious New York University's Petition chose to incorrectly claim

> *For other amateur licensees who attempt to "hear" a message sent using dynamic compression and ARQ, fading and interference will prevent those licensees from receiving an error-free copy of the message, thus effectively obscuring the dynamic compression key and the messages themselves for anyone other than the two locked stations. Other licensees will thus be unable to reconstruct the decoding and compression scheme and, by extension, unable to decode the message for true meaning.10*

despite all of the acknowledged expertise and accumulated knowledge possessed and taught at such a great University. Unless I have made some unexpected mistake, the application of diversity receiving techniques that are scores of years old, leads to the inescapable conclusion that not only is the ability to decode almost all WINLINK messages for true meaning possible, in fact it is ***very probable***, given only a few dedicated diversity systems.[50]

<u>But there's more....</u>

---

49 Gibby: https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf

50 Has there ***ever*** been a Single Sideband or FM voice message of 36,000 characters transcribed with 100% accuracy in the history of amateur radio? It seems to me that the transcription of WINLINK messages is well beyond anything that has ever been achieved in amateur radio before, for any voice technique. To send 36,000 characters at 20 wpm Morse Code would take 360 minutes, or 6 hours. I doubt that anyone has ever sent a CW message that long, let alone have it transcribed perfectly without a single fill.

The monitoring stations have an even further advantage, because the ARQ system and the difficulties that the intended recipient experiences gives them "luxury packets" where packets are repeated and the entire monitoring chain gets additional chances to monitor them! Thus ARQ works to their favor in this way. The more trouble the intended recipient is having....the better and better it gets for the monitoring stations.

2nd Approach: Working the monitoring problem using signal strength as per Tse

The above analysis assumed a determined monitoring group using available commercial (used or new) PACTOR modems. With the data captured in the reported experiment and the theory of diversity signal strength advantages taught by Tse[51], the problem can be reworked for the case where the monitoring system only uses Raspberry Pi receiving decoders. If the monitoring stations choose to be far cheaper ($500 transceiver, $100 Raspberry Pi, $50 soundcard, simple receiving antenna = < $700, less than a modern iPhone) then they will need a bit more of a reception advantage, estimated by the data above to be 3 dB or more. (If they are willing to spring for a more advanced Dragon Modem, or develop software to utilize the WA8DED hostmode in all SCS Modems, they can do with much less signal advantage!) Obviously due to the characteristics of ionospheric propagation, variations in received signal &/or fading with location will be FAR greater than 3 dB. Thus there will often (but not always) be stations who have a receptionally quite significant advantage (>>3dB) somewhere in a determined monitoring group of sufficient size to monitor the 65 HF RMS stations. . (An individual station of course, could easily be in a skip zone for a given single RMS station and not even hear any of the signals going to that station; this is the nature of HF communications.)

It is instructive to compare that required advantage to that provided by diversity receiving. Tse's chapter[52] explains that there are two different gain advantages to providing additional geographically diverse antennas/receiving stations. The first term ("array gain") adds 3dB with every doubling of diversity locations (arithmetic gain is linear with respect to diversity locations). Thus starting from only 1 station, adding a 2nd station gives 3dB; adding 2 more (total of 4) makes that term 6 dB and so on. The second term ("diversity gain") tends toward unimportance as Tse explains it. These results were derived for the case of coherent detection, and probably therefore are the optimal result; results with non-coherent detection may fall short.[53]

51 https://web.stanford.edu/~dntse/Chapters_PDF/Fundamentals_Wireless_Communication_chapter3.pdf

52 https://web.stanford.edu/~dntse/Chapters_PDF/Fundamentals_Wireless_Communication_chapter3.pdf Also see the sae result noted as the optimal outcome of antenna diversity in http://www.cs.yale.edu/homes/yry/readings/wireless/wireless_readings/Zheng_Tse_Tradeoff.pdf

53 I have't yet found derivations specific for non-coherent detection. Therefore I presume that Tse's results are the optimal possible.

We can break up the total received SNR conditioned on the channel gains into a product of two terms:

$$\|\mathbf{h}\|^2 \mathsf{SNR} = L\mathsf{SNR} \cdot \frac{1}{L}\|\mathbf{h}\|^2. \tag{3.71}$$

The first term corresponds to a *power gain* (also called *array gain*): by having multiple receive antennas and coherent combining at the receiver, the effective total received signal power increases linearly with L: doubling L yields a 3-dB power gain.[7] The second term reflects the *diversity gain*: by averaging over multiple independent signal paths, the probability that the overall gain is small is decreased.

Thus the determined monitoring group can significantly reduce the probability that ALL of their receiving stations are in the skip zone by increasing the number of diversity receiving stations, and can also add array gain with (as much as) 3dB gain for every doubling of their joint number. Let's assume that of the persons expressing grave concerns over the years (through FCC filings and other forums), the same number of dedicated volunteers (65) can (at least) be found. This would give the entire monitoring organization a theoretical diversity gain of as much as 18 dB -- which would be **plenty** to monitor any one station receiving a message at one time.

Compare an 18db S/N improvement to the curves demonstrated for the P3 process, in Figure 3 (Appendix). That graph reveals that less than 6 dB change can move the bit error rate from 50% [= coin toss] to 0.00001 This corroborates the above higher-level analysis that proved the incredible power of diversity reception.

> Note: I assume in this discussion that the monitoring will be suitably automated using PC's or Raspberry Pi's, similar to that level the WINLINK development has reached, so that receiver volunteers can simply leave their computers and radios performing, without attendance.

What about capturing ALL the messages? In October 2019, the entire Pactor 1, 2, 3 messages transferred over HF radio (worldwide) was 2,510.[54] Only some portion of those were in the United States, but assuming that each message transfer takes less <=10 minutes, there are 4,571 distinct 10-minute epochs in one month(exceeding the total number of PACTOR messages transferred) , so (as a first cut analysis) were the transmissions ideally separated, the entire 65 person monitoring network would easily be available for each and every transmission, making the entire diversity gain (potentially as great as 18dB) available! **Virtually every message would be captured.**

In practice, that helpful even spreading of the message traffic won't occur (and in order to monitor the other modes, we'll need those stations to do additional duties and likely also need additional volunteers from all those so concerned about this issue) -- but lets assume that we wish to monitor the **entire 21,831 HF messages** (transferred by any technique) during the month of October (even though many are international) and that we have 100 volunteers. Let's assume even distribution of the messages, 10 minutes per message. Thus we have approximately 6 messages being transferred simultaneously, so the automated system can assign 100/6 or 16 stations to each and every transmission by any HF mode at all (and ignore for the moment that it could intelligently assign those stations to get even higher

54 Using data from https://winlink.org/RMSChannels

benefit!) -- and still have up to 12 dB diversity reception gain, if we get even half of that, it is very likely going to succeed, even if only using any kind of computer that can run Linux (which I used to run on 80286 and 80386 computers) and connect to the Internet.

Then add the further advantage that once it were known that there is a determined group of volunteers who are just as willing to volunteer, as are WINLINK gateway volunteers, a sort of "herd immunity" will develop reducing objectionable behavior in the same way that Interstate Highways generally run at something close to the speed limit...because although the police cannot be everywhere, motorists are always aware they COULD be over the next hill.

For how long has this amazingly possible monitoring been technologically achievable?

Year	**Advancement**
1984	AX.25 Protocol 2[55]
1985	Release of the 80386 microprocessor[56]
1986	F6FBB begins development of FBB (which eventually uses FB protocol and dynamic compression)
1991	PACTOR 1 [57]
1992	MOSAIC browser[58]
1992	Winsock brings tcp/ip socket connections into WINDOWS operating system 1992 (based on the preexisting Berkeley sockets)[59]
1993	Release of the PENTIUM processor[60]
1993	Earliest documented usage of dynamic compression in FBB
1994	PACTOR 2 manual dated from 1994[61]
1995	FCC ruling on allowed digital techniques and requirement for technical documentation of newer techniques[62]
Before 1996	Creation of the WWW and existence of .> 50,000 connected networks[63]
1998	KDE Linux desktop environment[64]
c. 2000	**WL2K**
2001	Windows XP released[65]

55 https://en.wikipedia.org/wiki/AX.25
56 http://intel80386.com/
57 https://en.wikipedia.org/wiki/PACTOR
58 https://www.history.com/topics/inventions/invention-of-the-internet
59 https://en.wikipedia.org/wiki/Winsock
60 https://en.wikipedia.org/wiki/Pentium
61 https://www.p4dragon.com/download/SCS_Manual_PTC-II_4.0.pdf
62 FCC: https://docs.fcc.gov/public/attachments/DA-95-2106A1.pdf
63 https://www.internetsociety.org/internet/history-internet/brief-history-internet/
64 https://en.wikipedia.org/wiki/History_of_Linux

2004	PACTOR 3 technical description [66]

Table 5: Selected Relevant Historical Technological Advances

Based on these data, every technological advance necessary for the creation of an advanced network of determined volunteers monitoring WINLINK 2K has existed even well before the creation of Winlink 2000.

One then wonders why this effective monitoring system was never built. There are absolutely NO requirements in FCC regulations for the Winlink Development Team to build such a regulation system despite the attempts of detractors to attempt to find them. The Winlink Development Team made huge advances, and has given to Amateur Radio above and beyond. The Petition, and many supportive comments, readily report advanced technological knowledge and capabilities. The costs involved are minor, particularly given the advanced positions many comments have reported. All the required networking capabilities have existed for many years.

Perhaps the inescapable conclusion is that there was not sufficient actual perceived need for a monitoring system in a sufficient number of persons, to overcome some perceived startup barriers. Nevertheless, there ***was*** sufficient perceived need for the WINLINK development team and thousands of users to grow and grow.

5. Looking At Other Systems

The Petition expresses great concern over being able to monitor amateur radio transmissions. This inescapably brings up the question of monitoring all the other systems that utilize the same or similar technologies as WINLINK, including:

- D-RATS
- FBB
- GO
- FLDGI/FLMSG.

ALL of these developments are completely legal. However, to the untrained individual, their transmissions might "appear" to be "encrypted." To my knowledge, no one has created monitoring systems for over-the-air monitoring of ANY of these systems. The Petition uses the word "winlink" 22 times, but never *once* any of these other, similarly compressed and ARQ-connected systems.

I have previously highlighted these issues by providing over-the-air compressed text captured from FLDGI/FLMSG[67], and from D-RATS[68], and challenged those involved in these various discussions to read the D-RATS text. To my knowledge not a single person has yet succeeded, nor are there any

65 https://en.wikipedia.org/wiki/Windows_XP
66 https://www.p4dragon.com/download/PACTOR-3%20Protocol.pdf
67 See Appendix 5: https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf
68 See Appendix 7: https://ecfsapi.fcc.gov/file/10042734814100/InconvenientCorrections.pdf

extant monitoring software for FLDGI/FLMSG transmissions such as I provided, yet these systems are completely unencrypted. **The Petition provides no explanation for the apparent lack of interest, or discussion of any of these systems.**

Peter Helfert reports that he has received precisely zero feedback (other than mine) regarding the PMON software.[69]

Taken all together, there are now multiple findings suggestive of insufficient interest in actual over-the-air monitoring of compressed amateur radio signals, beyond that provided by the Winlink Viewer

- No interest expressed in the Petition related to multiple other systems utilizing same or similar protocols as WINLINK
- No presentation of data within the Petition regarding actual monitoring with existing tools created specifically for that purpose.
- No feedback to the creators of PMON, suggesting improvements or asking for assistance.

CONCLUSION

This fatally flawed Petition should be rejected, and in such a way that the matter cannot trouble all of us again. The Commission might reaffirm the goal for amateur radio to move forward rather than backwards.

69 Peter Helfert, Personal communication, November 15, 25, 2019. "We can state that SCS has not received any serious request for more protocol details as an support for developing a ham-based PMON. There seems to be little to no interest for such an application within the amateur community. Even the free PMON seems not to cause any significant monitoring activity – we have no received any feedback on results."

APPENDIX
Technical Details of Study, and Messages Received

Reducing Work Required To Test The Raspberry Pi Detection

The previous tests conducted over 900+ miles and monitored 9 miles from the closest station involved in the connection (and monitoring the signal coming from 900 miles away) were arduous to conduct in a pickup truck at a bus-stop, as if I were some sort of secret agent.[70] However, it was necessary to provide an unassailable test. It would be far easier to do this with established antennas in the comfort of a modern amateur radio station, or perhaps even using the freely available web SDR systems. Since the case of "secret-agent" monitoring (using the PMON software of the PACTOR modem) has already been accomplished repeatedly, there is little need to repeat this despite the Petition's lack of understanding of the results; instead attention now turns to the astonishing capture using only a Raspberry Pi and soundcard system, connected so as to utilize the same received signal that the special-purpose PACTOR modem is receiving.

The Superiority of Special-Purpose Hardware/Software

There is a problem with doing such a test. The special purpose PACTOR hardware/software took much research to develop, and commands a significant price in the free market, and the reason becomes quickly obvious when compared against other systems using only soundcards--- the PACTOR modem is an excellent and superior system. The developers explain that it includes advanced software such as "Memory ARQ"[71] [72](potentially as far back as Pactor-1[73])which remembers the strength of bits of previously captured portions of a mis-read packet, and uses those to improve the reading when the packet is re-sent. Apparently software to do that sort of advance hasn't been done by very many other developers, and it apparently is not yet included within the Raspberry Pi free software released. This gives the special purpose PACTOR modem some advantage; I was not quite sure how to model that in terms of dB.

As a result, if one tries to do a head-to-head test of the PACTOR modem driving an encounter, and the soundcard based system monitoring at the SAME LOCATION and seeing the SAME signal to noise ratio, the PACTOR modem will always win. Further, the PACTOR modem will advance the speed level (and thus raise the required signal to noise margin) until just the point where its advanced software is making occasional losses. But by then the free Raspberry Pi soundcard system is completely outclassed and no longer able to read the signal.

> I have already repeatedly explained[74] how determined monitors would make up for the advantages of the superior PACTOR modem: the basic solution is the use of internet-connected, diversity receiving stations. Despite the expressed concerns for the security of the United States, not even the plans for such a system are known by me to have been released. .

70 Gibby: https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf
71 SCS: https://www.p4dragon.com/download/PACTOR-2%20Protocol.pdf , see p. 2.
72 SCS: https://www.p4dragon.com/download/PACTOR-3%20Protocol.pdf , see p 5.
73 ARRL: http://www.arrl.org/pactor
74 For example, p2-3 of the filing on April 10, 2019: https://ecfsapi.fcc.gov/file/10410170249078/FCCRM11831-4.pdf

Therefore in order to properly experimentally estimate the level of advantage of that superior PACTOR modem system has, I chose to intentionally introduce white-noise into its input as a handicap, while attempting to give the Raspberry Pi soundcard system the unadulterated signal as much as possible. A simple resistor-based mixing system with a Baofeng receiver unsquelched and tuned to an unused FM channel provided this possibility as shown in the following hand drawn schematic.

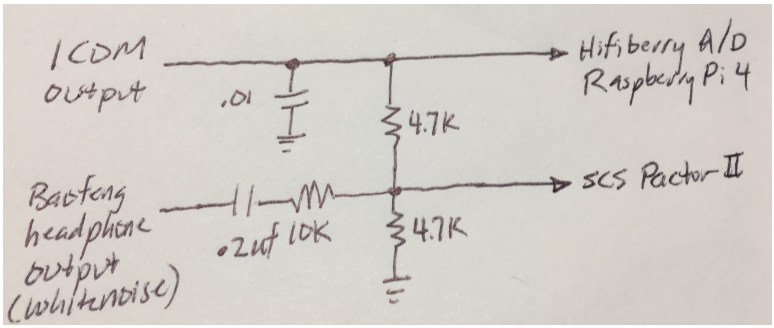

FIGURE 2. Simple mixer circuit to add audio white noise.

I'm sure that professional digital modulation developers have far better tools available, but I am aware of no such testing being released for the PMON Raspberry Pi system.

Limitation

This simple circuit provides added white noise at the audio end of the receiving system, not the RF input, since I don't have an elaborate testing setup. The ICOM 718 utilized in this experiment includes automatic gain control (AGC) which is not able to be turned off without cutting traces inside the radio. At low signal levels (e.g., during fading of the input signal toward background noise levels) the signal-to-noise (SNR) handicap given the PACTOR modem is predictable from voltage measurements. However, as the input RF signal rises, and the AGC somewhat reduces the receiver total gain, the added audio white noise is not commensurately reduced with the reduction in the receiver gain, causing the handicap to effectively enlarge. This further prevents the PACTOR modem from achieving the highest possible throughput, and lengthens the time and number of packets needed to receive the message. While this allows the Raspberry Pi system to enjoy a very nice SNR (a benefit), published data suggests that there is little further benefit beyond certain signal to noise ratios for the technique, as shown in the following published curves[75],

75 See page 3, https://www.p4dragon.com/download/PACTOR-3%20Protocol.pdf

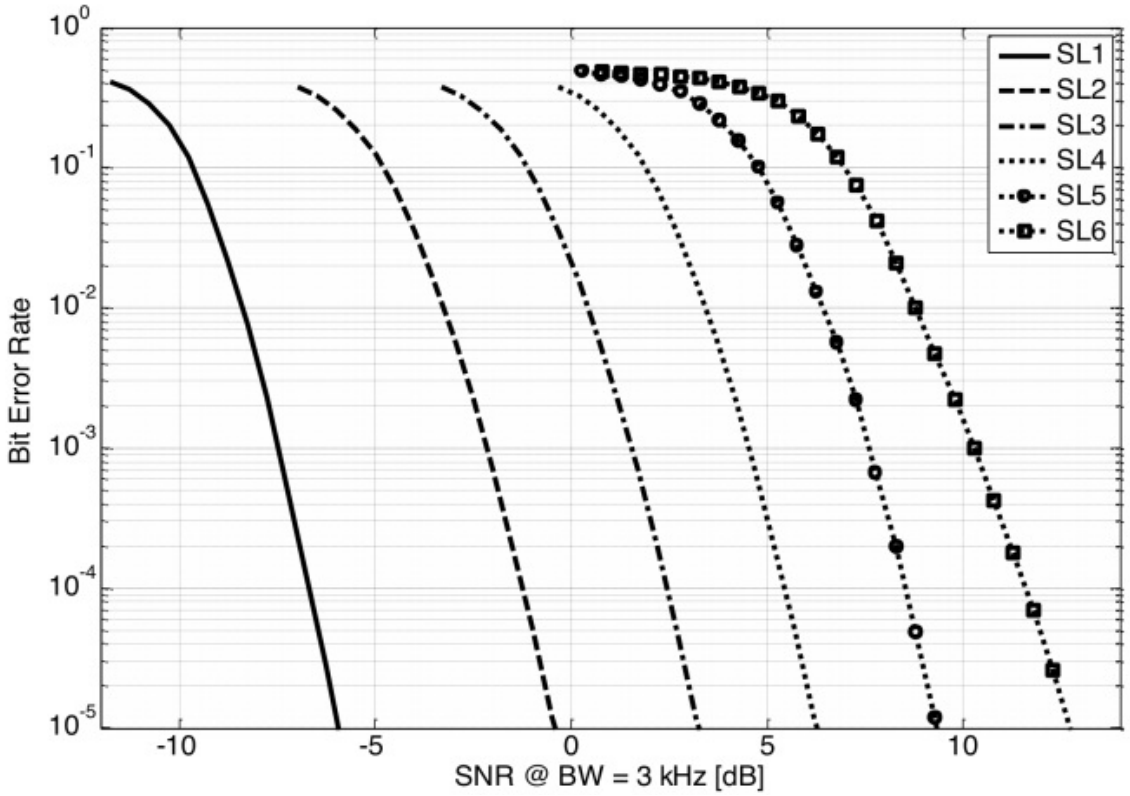

FIGURE 3. Published S/N Results and Bit Error Rate for Pactor 3
Curves demonstrate that for a given speed level, often only 6 dB moves the bit error rate from "coin-toss" accuracy to virtually zero; and that curves for adjacent speed levels are usually less than 5 dB apart. In typical observed practice, modems rapidly move to higher speed levels if packets are received without error and are somewhat "sticky" at the higher speed level.

and it also forces the Raspberry Pi to to have to succeed at even more packets (a **disadvantage**, resulting from the linked stations remaining at a lower speed level, and thus require more packets to move the message, given that packets are only allowed two different time lengths). Those effects may be somewhat counterbalancing. The primary benefit for my testing is to guarantee a floor or lower bound to the available signal margin, to which the superior PACTOR modem can drive the SNR presented to the Raspberry Pi. Subsequent experimenters may desire to repeat these experiments with a receiving system without AGC, or with RF-injected noise.

Experimental Record

The following are the records of that original experimental research. The actual messages (or partial messages as the case may be) are produced in the Appendix.

Date of experiment	November 15 2019

Transceiver	Icom 718
Antenna	Non resonant inverted vee, window feed line, 4:1 Balun, LDG AT600 tuner, 1:1 Balun (homemade)
PACTOR	SCS PTC-II upgraded to P3
Raspberry Pi	Pi 4, 4 Gbyte Ram
Monitoring Software	SCS free software PMON 1.0-2
White Noise Source	Baofeng UV-5R squelch set to 0, radio tuned to unused channel
Amateur Band	40 meters & 80 meters (amateur bands)
Oscilloscope	Siglent, using 10:1 probe
Background noise (not tuned to any station)	Approximately 488 mV peak-peak
White Noise measured at connection to PACTOR input	Approximately 700 mV peak to peak at conclusion of experiment, suggests approximately 3.3 dB noise penalty

Table 6: Experimental Setup

RESULT 1:----------

Received by Raspberry Pi on 80 meters:

Frequency	Gateway	Distance (miles)
3.588 MHz	WD4SEN	53

```
Date: 2019/11/15 17:34
From: K4WK
To: KX4Z
To: W4AKH
To: SMTP:jeffcapehart@gmail.com
To: W4UC
To: KF4DVF
To: KV4LY
To: SMTP:roywfgs@cox.net
To: K4HBN
Subject: //WL2K pls send me your conventional email addresses
Mbo: K4WK
Body: 104
```

```
Both my Red Cross and my comcast email clients are hiccuping on the
winlink,org email addresses.  Tnx
```

(Perfect reception)

RESULT 2:----------

Another message on 80 meters

Frequency	Gateway	Distance
3.588 MHz	WD4SEN	53

```
MID: 7FRN861K2C0L
Date: 2019/11/15 19:13
From: KG4ARC
To: SMTP:cwa01@comcast.net
To: SMTP:bob.lirtzman@redcross.org
To: SMTP:michael.hoeft@redcross.org
To: SMTP:carl.piojda@redcross.org
To: KX4Z
To: W4AKH
To: SMTP:jeffcapehart@gmail.com
To: W4UC
To: KF4DVF
To: KV4LY
To: SMTP:roywfqs@cox.net
To: K4HBN
Subject: //WL2K Echolink try out
Mbo: KG4ARC
Body: 101

If you are available this afternoon, let's have a quick meetup on Echolink
node N4SBD-R at 3pm EST.
```

(perfect reception)

RESULT 3:----------

INCOMPLETE
missed the last portion of this message

Frequency	Gateway	Distance
3.588 MHz	WD4SEN	53

```
MID: OXQB0DNPOVIM
Date: 2019/11/15 17:42
From: K4WK
To: SMTP:carl.piojda@redcross.org
```

```
To: SMTP:cwa01@comcast.net
To: SMTP:michael.hoeft@redcross.org
To: KX4Z
To: W4AKH
To: SMTP:jeffcapehart@gmail.com
To: W4UC
To: KF4DVF
To: KV4LY
To: SMTP:roywfgs@cox.net
To: K4HBN
To: SMTP:bob.lirtzman@redcross.org
Subject: //WL2K Pictures!
Mbo: K4WK
Body: 359

Please take some good photos of your operations this Saturday for me for
future PR.  Here's a list:

    picture of self at your r
```

INCOMPLETE RECEPTION

RESULT 4:----------

I turned the noise up a bit (to the 3.3 dB measured at the end); went to 40 meters. Got this entire message flawlessly at 600 bps [number demonstrated on WINLINK EXPRESS software]

Frequency	Gateway	Distance
7.1037	AJ4FW	534

```
MID: 8GVI94IQ4S0Z
Date: 2019/11/15 20:36
From: KG4ARC
To: SMTP:cwa01@comcast.net
To: SMTP:carl.piojda@redcross.org
To: KX4Z
To: W4AKH
To: SMTP:jeffcapehart@gmail.com
To: W4UC
To: KF4DVF
To: KV4LY
To: SMTP:roywfgs@cox.net
To: K4HBN
Subject: Re://WL2K Echolink try out
Mbo: KG4ARC
Body: 721

One station came on at 3pm.  Guess it wasn't a good time for most of us.

Pls let me know any other time today or this evening you like to try this.
```

```
Doesn't matter where you are; the node is in Atlanta but the other station
who came on is in New York.


----- Message from KG4ARC sent 2019/11/15 19:13 -----

Message ID: 7FRN861K2C0L
Date: 2019/11/15 19:13
From: KG4ARC
To: cwa01@comcast.net; bob.lirtzman@redcross.org; michael.hoeft@redcross.org;
carl.piojda@redcross.org; KX4Z; W4AKH; jeffcapehart@gmail.com; W4UC; KF4DVF;
KV4LY; roywfgs@cox.net; K4HBN
Source: KG4ARC


Subject: //WL2K Echolink try out

If you are available this afternoon, let's have a quick meetup on Echolink
node N4SBD-R at 3pm EST
```

PERFECT RECEPTION of a message that included multiple previous notes.

RESULT 5:----------

80 meters -- During this experiment, signal completely faded and disappeared several times. Went to 8 or more repeats several times. WW4MSK, 400 miles from me on 80 meters. Raspberry Pi System got the body of the message, but lost it somewhere in the attachment.

Frequency	Gateway	Distance
3.5925 MHz	WW4MSK	377

```
MID: PZ38FRVVFAA7
Date: 2019/11/15 17:30
From: K4WK
To: KX4Z
To: W4AKH
To: SMTP:jeffcapehart@gmail.com
To: W4UC
To: KF4DVF
To: KV4LY
To: SMTP:roywfgs@cox.net
To: K4HBN
Cc: K4WK
Subject: //WL2K test msg of tiny k2s form
Mbo: K4WK
Body: 211
File: 1007 Mickey_Mouse_seeking_Minnie_-_K4WK-20191112-175235L-4.k2s
```

```
Open the msg, save the attachment to your NBEMS.files\ICS\messages folder,
then you can open with flmsg.

Sorry this is so complicated; I didn't make it up but I am powerless to make
it simpler.

Rgds, Wayne
<flmsg>4.0.11
:hdr_ed:20
K4WK 20191211225253
<customform>
:mg:892 CUSTOM_FORM,ARC_Emergency_Welfare_Inquiry_Form_v_1.0.html
DRONum,9999-99
ARCVolName,Robertson
ARCVolCity,Decatur
ARCVolState,Georgia
ARCVolZip,30030
ARCName,Mouse
ARCName,Mouse
ARCInitial,
ContactAddress,1313 Disneyland Drive
ContactCity,Anaheim
ContactState,CA
ContactZip,12345
Contactcountry,United States
87,14,BB,13,62,54,BE,AE,63,F0,1A,24,42,14,5B,ED,67,A4,0E,E3,3F,14,5A,39,4A,46
,31,6E,9C,E0,38,7C
3D,9F,F9,3B,80,D7,E8,58,9C,D2,CE,3F,D7,CF,1E,AF,CC,7D,23,EC,2E,1B,FE,F8,99,BF
,78,E4,9D,11,F4,6A,CF,20,66
84,B0,4C,B4,5D,F0,C7,23,7B,FA,EA,0A,13,99,8C,D7,4F,81,06,CC,8D,48,81,D1,63,50
,22,A8,C2,F0,9E,9E,82,56,0B,6C
9D,9D,A7,F6,1E,F9,A0,EA,E7,43,06,93,43,B5,66,00,19,5E,C6,6D,10,14,B0,98,6D,59
,93,59,B2,4C,68,69,9B
A5,F5,4F,7E,CD,80,77,29,6A,25,BE,C6,6B,94,F9,A0,93,94,40,7C,E3,36,BA,A5,9A,A1
,10,E0,12,84,D4,EE,A0,89,6D
4E,68,C0,BC,16,75,1E,81,D7,F2,B3,CC,3B,BC,3F,A5,91,6F,07,8E,B1,02,B1,01,2E,BE
,C1,34,4D,4C,BE,88,4C
0F,CD,90,A7,DE,F8,A6,16,84,17,85,2F,58,39,91,4B,7C,CC,01,16,A5,B9,86,94,06,D6
,0A,7D,A8,BA,7F,CE,9D
F4,8D,8D,DD,89,8E,CA,2F,BB,40,43,A4,A2,B0,E8,15,AA,10,7A,6E,76,91,B3,FA,FA,00
,83,92,05,D3,64,D4,3E,E7
21,0B,F2,86,F6,B8,0D,0A,DF,96,9B,E7,F1,9D,FC,4C,4C,05,46,39,B3,4E,0F,E3,5F,CD
,F4,F4,74,F8,53,ED,83,3E,FE,03
C0,05,AA,21,8D,A7,A1,AF,17,48,10,00,B2,37,D0,D1,37,22,43,49,FF,4A,D4,9D,94,A2
,2F,F0,03,04,00,04,CA
EM 7U
```

Captured message, did not capture the attachment.

RESULT 6: ----------

Raspberry Pi PMON missed one message completely Unclear why (likely missed the required characters to initiate the capture apparently)

RESULT 7: ----------The surprising one----------

This is the most surprising experiment result, and example of the Raspberry Pi capturing a portion of the message (and immediately delivering it due to the advancement of the LZHUF routine by Peter Helfert) --- but the intended recipient (the Pactor modem and WINLINK software) reached the maximum number of retries and aborted -- which means nothing was provided to view, at all.

Notes created at time of experiment:
40 meters to kb5lzk. signal is dropping out. pmon got a bunch and then lost it. The pactor is struggling.-- and eventually QUIT -- so the intended recipient computer NEVER got to read the message. Meanwhile, the monitor gets to read a good portion!

Frequency	Gateway	Distance (miles)
7.1016 MHz	KB5LZK	669

```
PACTOR-1/2/3 Monitor started:
=============================

utes remaining with KB5LZK
{SFI = 070 On 2019-11-15 23:00 UTC}

Welcome to KB5LZK at the Ar Division of EmerM$]
;PQ: 23700977
CMS via KB5LZK >
: KX4Z ROLRRFM1SU3R 3505 wayne.robertson@redcross.org Re: [EXTERNAL]
Re: //WL2K FL WL Participation in Red Cross ARES Radio
;PM: KX4Z D4NFDDU80NY0 3523 wayne.robertson@redcross.org Re: [EXTERNAL]
Re: //WL2K FL WL Participation in Red Cross ARES Radio
;PM: KX4Z 7U9N9396PDZR 3718 wayne.robertson@redcross.org Re: [EXTERNAL]
Re: //WL2K FL WL Participation in Red Cross ARES Radio
;PM: KX4Z 5GP3GTT8YDC7 3803 jeffcapehart@gmail.com Re: [EXTERNAL]
Re: //WL2K FL WL Participation in Red Cross ARES Radio
FC EM ROLRRFM1SU3R 6563 3505 0
FC EM D4NFMID: ROLRRFM1SU3R
Date: 2019/11/15 19:33
From: SMTP:wayne.robertson@redcross.org
To: KX4Z
To: W4AKH
Subject: Re: [EXTERNAL] Re: //WL2K FL WL Participation in Red Cross
```

ARES Radio
Mbo: SMTP
Body: 6353

Let's try Echolink today at 3pm Eastern time; N4SBD-R.

_____
From: KX4Z@winlink.org <KX4Z@winlink.org>
Sent: Friday, November 15, 2019 7:26 AM
To: W4AKH@winlink.org <W4AKH@winlink.org>; Robertson, Wayne <wayne.robertson@redcross.org>
Cc: jeffcapehart@gmail.com <jeffcapehart@gmail.com>
Subject: [EXTERNAL] Re: //WL2K FL WL Participation in Red Cross ARES Radio Drill Nov 16

Thank you for the information below. However, I am unable to

a___ - Sn
!cyRm_s
_5RbtW_Ca9
1_ iKH@winlink.orgo__:a_w.l ahima_T aNF_unaa
c<R1BD,6E,F0,E2,F4,EB,2E,2F,63,88,65,EF,B8,0B,D3,6D,0F,4C,81,68,9B,FF,E9,CE,02,B2,5C,49,57,C9,E3,8E,61,40,78
^Cpi@raspberrypi:~ $